Unique Polymeric Materials by Novel Processes

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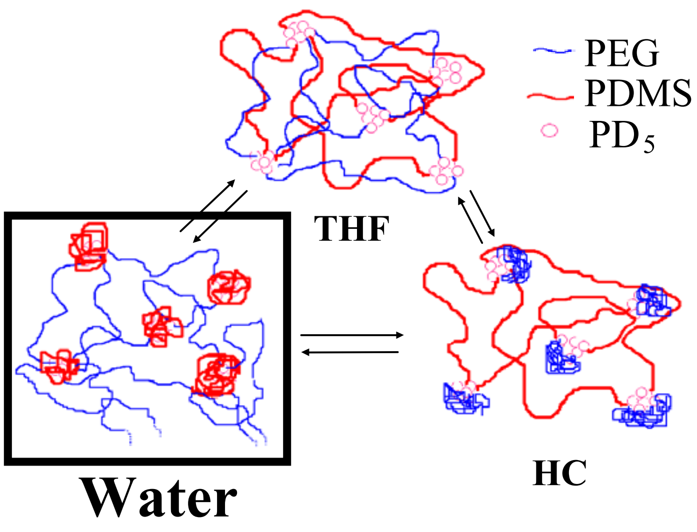
Part of this project is the design, synthesis and characterization of "smart" amphiphilic networks, i.e., networks comprising both hydrophilic and hydrophobic strands that change their morphology (conformation) depending on the medium they are in contact. These networks are of potential use for ultrafiltration, controlled drug delivery, and, most importantly, as immunoisolatory membranes for implanted living tissue (e.g., pancreatic beta cells) to correct chronic diseases (e.g., diabetes). Our latest *patented* (U.S. 6,528,584) networks are made of poly(ethylene glycol) (PEG) and silicon rubber (PDMS) strands crosslinked with cyclic polysiloxanes (PD_5). Synthetic procedures have been developed for the convenient laboratory preparation of these membranes. Swollen amphiphilic networks rapidly and reversibly change their conformations upon exposure to different liquids (water, hydrocarbons, THF). The sketch helps to visualize the nanostructure of the networks and their reversible change when exposed to different liquids. The pore/channel dimensions of the devices can be controlled by the lengths (molecular weights) of the strands while their overall composition can be controlled by the relative amounts of the three ingredients used in the synthesis. The membranes are biocompatible and their mechanical properties are satisfactory for encapsulation of living tissue. The devices are sterilizable.

Nanostructure of "SMART" Membranes



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Education/Outreach

This project involves three PhD graduate students, a postdoctoral researcher, and a visiting scientist. A model of an experimental “smart” amphiphilic network was built by the use of colored pipe-cleaners exemplifying the two kinds of strands of the network (blue = hydrophilic, red = hydrophobic) and small polystyrene balls for the crosslinking sites (PD_5). The fundamental architecture of the networks can be studied with such models. The models are also used to demonstrate to visitors the principle of network response due to medium changes. The picture shows the PI explaining the workings of a ”smart” amphiphilic network to a high school teacher (Ms. J. Garcia, Kenmore High School) and a student (Ms. E. Rose) with the help of the molecular model of PEG/PD5/PDMS. The relative amounts of the colored pipe-cleaners are proportional to the relative amount of the strands in the network, whereas the lengths of the blue and red pipe-cleaners are proportional to the lengths of the hydrophilic and hydrophobic strands, respectively.